

Alcoholic Beverage Consumption

CAS No.: none assigned

Known to be a human carcinogen

First listed in the *Ninth Report on Carcinogens* (2000)

Carcinogenicity

Consumption of alcoholic beverages is *known to be a human carcinogen* based on sufficient evidence of carcinogenicity from studies in humans.

Cancer Studies in Humans

Studies indicate that the risk of cancer from consumption of alcoholic beverages is most pronounced among smokers and at the highest levels of consumption. Consumption of alcoholic beverages has been shown to cause cancer of the mouth, pharynx, larynx, and esophagus. Cohort and case-control epidemiological studies in a variety of human populations are consistent in reporting moderate to strong associations between alcohol consumption and cancer at these four sites, and the risk of cancer increases with increasing consumption level. The effect of a given level of alcoholic beverage intake on the absolute risk of cancer at these four tissue sites is influenced by other factors, especially smoking. However, smoking does not explain the observed increased risk of cancer associated with increased alcoholic beverage consumption. Evidence also supports a weaker, but possibly causal, relationship between alcoholic beverage consumption and cancer of the liver and breast (IARC 1988, Longnecker 1994, Longnecker and Enger 1996).

Since alcoholic beverage consumption was reviewed for listing in the *Ninth Report on Carcinogens* in 2000, the International Agency for Research on Cancer has reevaluated the evidence for the carcinogenicity of alcoholic beverage consumption (Baan *et al.* 2007, Secretan *et al.* 2009) and concluded that there was sufficient evidence of carcinogenicity in humans. The 2007 and 2009 reviews concluded that alcoholic beverage consumption caused cancer of the mouth, pharynx, larynx, esophagus, liver, colorectum, and female breast.

Cancer Studies in Experimental Animals

No adequate studies of the carcinogenicity of alcoholic beverages in experimental animal have been reported. The results of studies specifically examining the carcinogenicity of ethanol in experimental animals do not suggest that the ethanol component of alcoholic beverages is solely responsible for the increased risk of cancer associated with human consumption of alcoholic beverages.

Studies on Mechanisms of Carcinogenesis

The mechanism by which consumption of alcoholic beverages causes cancer in humans has not been established. Increased frequencies of chromosomal aberrations, sister chromatid exchange, and aneuploidy were found in the peripheral-blood lymphocytes of alcoholics. Ethanol-free extracts of some alcoholic beverages caused mutations in bacteria and sister chromatid exchange in cultured human cells (IARC 1988).

Properties

Ethanol and water are the main constituents of most alcoholic beverages. Based on the standard measures for most drinks, the amount of ethanol consumed is similar for beer, wine, and spirits (10 to 14 g). Beer, wine, and spirits also contain volatile and nonvolatile flavor compounds that originate from raw materials, fermentation, wooden casks used for maturation, and synthetic substances added to spe-

cially flavored beverages. Although the exact composition of many alcoholic beverages is confidential business information, many studies have identified the organic compounds typically present at low levels. Several of the components and contaminants identified in beer, wine, and spirits are known or suspected human carcinogens, including acetaldehyde, nitrosamines, aflatoxins, ethyl carbamate (urethane), asbestos, and arsenic compounds (IARC 1988).

Use

Alcoholic beverages have been made and used by most societies for thousands of years (IARC 1988). Consumption trends, including overall level of alcohol consumption, beverage choice, age and sex differences, and temporal variations, differ among and within societies. In many cultures, alcohol also has been used in medicine and various pharmaceutical preparations, in religious observances, and in feasting and celebrations.

Production

All alcoholic beverages are produced by the fermentation of fruit or other vegetable matter. Most commercial and home production is of fermented beverages that are classified, based on raw materials and production methods used, as beer, wine, or spirits; smaller quantities of other kinds of fermented beverages (e.g., cider, rice wine, palm wine) also are produced. Beer is produced by fermentation of malted barley or other cereals with the addition of hops. Wine is made from fermented grape juice or crushed grapes; fortified wines include additional distilled spirits. Distilled spirits originate from sources of starch or sugar, including cereals, molasses from sugar beets, grapes, potatoes, cherries, plums, and other fruits; after sugar fermentation, the alcohol content is increased by means of liquid distillation. Although ethanol can be chemically synthesized from ethylene, the alcoholic beverage industry does not synthesize alcohol for use in beverages, because of the presence of impurities from the synthetic process (IARC 1988).

In 1990, the United States produced 4.5 million metric tons (10 billion pounds) of wine, 375 million hectoliters (10 billion gallons) of beer, and 18.5 million hectoliters (490 million gallons) of spirits (ARF 1994). Total world production was 29 million metric tons (6.4 billion pounds) of beer, 1 million hectoliters (26.4 million gallons) of wine, and 58 million hectoliters (1.5 billion gallons) of spirits. In 2008, U.S. per-capita consumption was 21.8 gal of beer, 2.5 gal of wine, and 1.4 gal of distilled spirits (USDA 2010). In 2009, U.S. imports and exports of various categories of beer, wine, distilled spirits, and other alcoholic beverages ranged from millions to billions of liters (USITC 2009).

Exposure

Alcohol consumption showed a downward trend in the United States and many European countries from the turn of the twentieth century until the period between the two world wars. U.S. alcohol consumption increased from the 1940s until the early 1980s and then began a steady decrease. By 1993, consumption reached the lowest level since 1964; apparent per-capita consumption expressed in gallons of pure alcohol per year was approximately 1.6 gal in 1940, 2.2 gal in 1964, 2.8 gal in 1980, and 2.2 gal in 1993. Most of the decrease in alcohol consumption can be attributed to decreased consumption of spirits. While overall alcohol consumption was falling, per-capita consumption of wine and beer in the United States was relatively stable from the early 1980s into the 1990s (Williams *et al.* 1995). Per-capita consumption of wine was the same in 1993 as in 1977, while consumption of spirits fell by almost 35% over the same period. Per-capita consumption of beer decreased from 1981 to 1985, fluctuated there-

Report on Carcinogens, Twelfth Edition (2011)

after, and in 1993 was 1% below 1977 consumption levels (NIAAA 1997). The total number of drinks consumed in the United States in 1999 was about 65.5 billion for beer, 13.7 billion for wine, and 29.3 billion for distilled spirits. Underage drinkers (aged 12 to 20) consumed 19.7% of the total, and adult excessive drinkers (more than 2 drinks per day) consumed 46.3%. The heaviest adult drinkers (highest 2.5%) consumed 27% of the total (Foster *et al.* 2003).

Since 1971, the Substance Abuse and Mental Health Services Administration has conducted an annual survey on the use of alcohol, tobacco, and illicit drugs by the civilian noninstitutionalized population of the United States aged 12 years or older (SAMHSA 2009). This survey, now called the National Survey on Drug Use and Health (formerly the National Household Survey on Drug Abuse) reports prevalence and trends of alcohol consumption at three levels: (1) current use (at least one drink in the past 30 days), (2) binge use (five or more drinks on the same occasion at least once in the past 30 days), and (3) heavy use (five or more drinks on the same occasion on at least 5 different days in the past 30 days). In the 2008 survey, 51.6% of respondents reported alcohol use during the past year; this was significantly lower than the 61.9% reported in 2000 and the peak of 72.9% reported in 1979 (Foster *et al.* 2003, SAMHSA 2009). In 2008, 51.6% of respondents (about 129 million) were current drinkers, 23.3% (about 58.1 million) were binge drinkers, and 6.9% (about 17.3 million) were heavy drinkers. Both binge and heavy drinking were most prevalent among young adults (aged 18 to 25). In all age groups except the youngest (aged 12 to 17), men were more likely than women to report drinking alcohol in the past month (SAMHSA 2009).

Regulations

Bureau of Alcohol, Tobacco, Firearms, and Explosives

Alcoholic beverages sold or distributed in the United States, or to members of the Armed Forces outside the United States, must contain a specified health-warning label.

References

- ARF. 1994. *International Profile, Alcohol and Other Drugs*. Toronto, Ontario: Addiction Research Foundation of Ontario. 174 pp.
- Baan R, Straif K, Grosse Y, Secretan B, El Ghissassi F, Bouvard V, Altieri A, Coglian V. 2007. Carcinogenicity of alcoholic beverages. *Lancet Oncol* 8(4): 292-293.
- Foster SE, Vaughan RD, Foster WH, Califano JA, Jr. 2003. Alcohol consumption and expenditures for underage drinking and adult excessive drinking. *JAMA* 289(8): 989-995.
- IARC. 1988. *Alcohol Drinking*. IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Humans, vol. 44. Lyon, France: International Agency for Research on Cancer. 416 pp.
- Longnecker MP. 1994. Alcoholic beverage consumption in relation to risk of breast cancer: meta-analysis and review. *Cancer Causes Control* 5(1): 73-82.
- Longnecker MP, Enger SM. 1996. Epidemiologic data on alcoholic beverage consumption and risk of cancer. *Clin Chim Acta* 246(1-2): 121-141.
- NIAAA. 1997. *Ninth Special Report to Congress on Alcohol and Health*. NIH Publication No. 97-4017. Washington, DC: National Institute on Alcohol Abuse and Alcoholism. 420 pp.
- SAMHSA. 2009. *Results from the 2008 National Survey on Drug Use and Health: National Findings*. Department of Health and Human Services, Substance Abuse and Mental Health Services Administration. <http://www.oas.samhsa.gov/nsduh/2k8nsduh/2k8Results.pdf>. 286 pp.
- Secretan B, Straif K, Baan R, Grosse Y, El Ghissassi F, Bouvard V, *et al.* 2009. A review of human carcinogens—Part E: tobacco, areca nut, alcohol, coal smoke, and salted fish. *Lancet Oncol* 10(11): 1033-1034.
- USDA. 2010. *ERS/USDA Data: Food Availability (Per Capita) Data System*. U.S. Department of Agriculture Economic Research Service. <http://www.ers.usda.gov/Data/FoodConsumption/app/availability.aspx> and select Beverages by subgroup and then Alcoholic beverages.
- USITC. 2009. *USITC Interactive Tariff and Trade DataWeb*. United States International Trade Commission. http://dataweb.usitc.gov/scripts/user_set.asp and search on HTS nos. 2203, 2204, 2205, 2206, and 2208. Last accessed: 10/20/09.
- Williams GD, Stinson FA, Stewart SL, Dufour MC. 1995. *Apparent Per Capita Alcohol Consumption; National, State and Regional Trends, 1977-92*. Rockville, MD: National Institute on Alcohol Abuse and Alcoholism.